MULTIMEDIA UNIVERSITY

SUPPLEMENTARY EXAMINATION

TRIMESTER 1, 2015/2016

PCM0035 – GENERAL CHEMISTRY
(All sections / Groups)

17 NOV 2015
9.00 AM – 11.00 AM
(2 HOURS)

INSTRUCTIONS TO STUDENT

1. This question paper consists of 3 pages only excluding the cover page.

2. Attempt **ALL** questions. Distribution of the marks for each question is given.

3. Please write all your answers in the answer booklet provided.

QUESTION 1 [20 MARKS]

a) Answer the following.
 i) Draw the Lewis symbols for Mg^{2+} and P^{3-}.   [1 mark]
 ii) Draw the Lewis structures and state the total number of valence electrons for the compounds of dihydrogen dioxide (H_2O_2) and hydroxidooxidonitrogen (HNO_2).   [4 marks]

b) Among the exceptions to the octet rule are the odd-electron molecule and the expanded octet. For each exception, provide a specific example of a molecule. Draw the Lewis structure for each specific example and explain why it does not follow the octet rule.   [4 marks]

c) Given that the energy of a photon emitted by a hydrogen atom is -4.905×10^{-20} J.
 $[R_H = 2.18 \times 10^{-18}$ J; $h = 6.63 \times 10^{-34}$ J.s; $c = 3.00 \times 10^8$ m/s]
 i) Find the wavelength of the photon emitted by the hydrogen atom. [2 marks]
 ii) Determine the initial state (n_i) of the electron from the hydrogen atom, if it moves to a final state of $n = 4$.   [3 marks]

d) Write the quantum number values of n, l and m_l for $2p$-orbitals. [1 mark]

e) Which of the following species has the largest size and which has the smallest size. Justify your answer.
$$Na, \quad Na^+, \quad Al, \quad Al^{3+}$$
                        [2 marks]

f) Write the *electron configurations* for the elements given below and determine the group in the periodic table that each element belongs to.
 i) Element with atomic number = 14   [1 mark]
 ii) Element with atomic number = 6   [1 mark]
 iii) Element with atomic number = 20   [1 mark]

QUESTION 2 [20 MARKS]

a) The following molecules have different boiling points and viscosity. Predict which one has higher boiling point and larger viscosity. Explain your answer.

(i)	1-propanol	$H_3C{-}O{-}CH_3$ Methoxyethane
(ii)	HCl	HF

                        [4 marks]

b) **Figure 1** shows a phase diagram of carbon dioxide.
 i) Name point E.   [1 mark]
 ii) Predict the most stable physical state at point D.   [0.5 mark]
 iii) What happens if temperature is decreased from point z to point y. [0.5 mark]
 iv) How does this diagram differ from phase diagram of water? [1 mark]
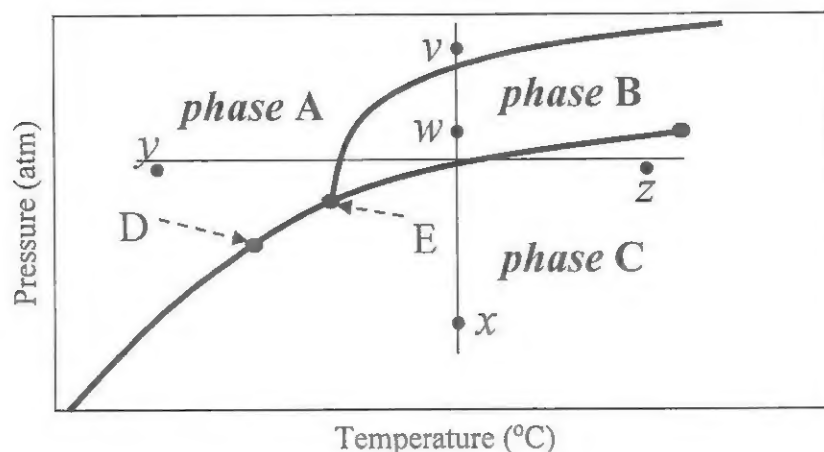
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Figure 1

c) For the reaction: $C + D \longrightarrow E$, the rate equation is given by: Rate $= k\,[C]^2\,[D]$.
    Answer the questions below:
    i)   What is the overall order of reaction.   [1 mark]
    ii)   Find the unit for the rate constant, k.   [2 marks]
    iii) What will happen to the rate if the concentration of A is doubled.   [1 mark]
    iv)   What will happen to the rate if the concentration of B is halved.   [1 mark]
    v)   What will happen to the rate if the concentration of A is doubled and the
          concentration of B is halved, assuming all changes take place at constant
          temperature?   [1 mark]

d) Consider the following reaction at a particular temperature:

$$NO_2\,(g) + N_2O\,(g) \rightleftharpoons 3\,NO\,(g)$$

Given that the equilibrium concentrations are $[NO_2] = 2.50$ M, $[N_2O] = 3.60$ M and
$[NO] = 0.003$ M,
    i)   What is the value of the equilibrium constant, K_c?   [2 marks]
    ii)   If [NO] is removed from the system at equilibrium, which direction will the
          reaction shift?   [1 mark]

e) The following data were measured for the reaction,

$$CH_4\,(g) + 2\,O_2\,(g) \rightarrow CO_2\,(g) + 2\,H_2O\,(g)$$

Experiment	[CH$_4$]	[O$_2$]	Initial Rate (M/s)
A	0.25	0.24	0.2130
B	0.25	0.12	0.1065
C	0.36	0.10	0.1192
D	0.18	0.10	0.0596

    i)   Find the rate law for the reaction.   [3 marks]
    ii)   Determine the overall order of the reaction?   [1 mark]

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QUESTION 3 [20 MARKS]

a) For the reaction below, indicate the Brønsted-Lowry acid and conjugate base.

$$HCO_3^-(aq) + H_2O(l) \rightleftharpoons H_2CO_3(aq) + OH^-(aq)$$ [2 marks]
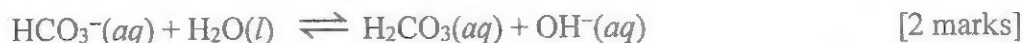
b) Determine the concentration of OH^- ion at 25 °C for each solution below and determine whether it is acidic, basic or neutral.

i) $[H^+] = 7.5 \times 10^{-5}$ M [2 marks]

ii) $[H^+] = 1.0 \times 10^{-7}$ M [2 marks]

c) Calculate how many grams of NaOH is needed to prepare a 0.52 L solution with pH 7.5. [Atomic mass: Na = 23; O = 16; H = 1] [3 marks]

d) Automobile batteries use 3.00 M of H_2SO_4 as an electrolyte. How many liters of 1.20 M of NaOH will be needed to neutralize 2225 mL of automobile battery acid? The balanced chemical equation for the neutralization process is given below:

$$H_2SO_4 \ (aq) \ + \ 2\ NaOH \ (aq) \ \rightarrow \ 2\ H_2O \ (l) \ + \ Na_2SO_4 \ (aq)$$
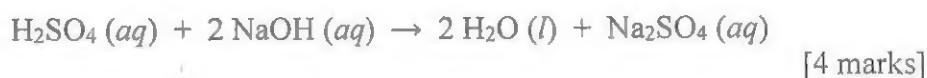
[4 marks]

e) A metal, X reacts with bromine to form XBr_3. Continuous electrolysis of XBr_3 by a steady current of 5.62 A for half an hour deposits 3.25 g of the metal, X. Calculate the molar mass of the metal, X. [Faraday constant = 96 500 C/mol e^-] [3 marks]

f) Based on their electronegativity and/or molecular structure, pick which acid is stronger and give reasons.

i) HF or HI [2 marks]

ii) HClO or $HClO_3$ [2 marks]

End of Paper